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# Development of novel organic plant protection products as alternatives to copper

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# Existing and experimental alternatives

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Are there alternatives to copper for controlling grapevine downy mildew in organic viticulture?

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**112 products tested:**

only few gave some efficacy, however high costs of production, toxicity, inconsistency, etc.



## Tested products overview

Chitosan

Hydrolyzed proteins, milk proteins, whey

Lactoperoxidase system

Propolis

Microorganisms: *Trichoderma* spp., *Fusarium* spp., *Bacillus* spp., *Pseudomonas* sp.

Homeopathic preparations

Zeolite, clays

Potassium bicarbonate, calcium carbonate, kaolin, aluminium oxide, silicium oxide

Rhamnolipid biosurfactant, fatty acids, saponin Brassica napus oil

Lignin derivatives

Compost tea of humus extracts

Resveratrol

Essential oils or extracts of *Melaleuca alternifolia*, *Thymbra spicata*, *Eugenia caryophyllata*, *Polygonum aviculare*, *Glycyrrhiza glabra*, *Salvia officinalis*, orange oil, limonene, *Moringa oleifera*, *Yucca schidigera*, *Abies sibirica*, *Quercus* sp., *Quillaja saponaria*, *Chenopodium quinoa*, *Rheum rhabarbarum*, *Inula viscosa*, *Solidago virgaurea*, *Salix alba*, *Camellia oleifera*, *C. quinoa*, *Thymus* sp., *Achillea millefolium*, *Urtica dioica*

*Ascophyllum nodosum* (seaweed)

Electrolyzed acid water

Ozonated water + UV irradiation

Beta-aminobutyric acid

# Existing alternatives to copper: why do we need new products?

- Limited efficacy (max 30-40%) or inconsistency
- Effective only at low disease pressure
- Short persistency
- Low rainfastness

**State of the art:** *growers apply low copper dosages according weather conditions (yield or quality losses, copper not allowed in some countries, need for copper replacement)*

# Main running project on alternatives to copper

Various PPPs (EU project)



Microalgal strains (EU project)



Various PPPs (EU project)



Several national or regional projects

# PPPs developed in Cofree

**Active ingredients** already proven to be effective (**TRL\* 4-5**): optimization of extraction, formulation, timing of application

- **6 PPPs** from microbial origin
- **7 PPPs** from plant or natural origin

Research centers and companies working together in the implementation

Aim: to reach **TRL9 by the end of project**

\*TRL: Technology Readiness Level

# PPPs tested in Cofree: overview

More than 20 candidates (active ingredients × various formulations) have been evaluated

**Ecotox assessment:** all tested PPPs indicated very low or no toxicity to non target organisms (parasitoids/predatory insects, non-target soil indicators, aquatic organisms)

**Efficacy of PPPs:** in the best cases it is similar to copper

**Economic sustainability:** they are likely to cost more than copper (+10-100%)

# Evaluation under field conditions



Product as stand alone treatment*	Efficacy**
<b>Plant extract 1</b>	M-H
<b>Plant extract 2</b>	M-H
<b>Plant extract 3</b>	L-H
<b>Milk derivative</b>	M-H
<b>Bacterium 1</b>	M-H
Microbial derivate	L-M
Fungus 1	L
Oligosaccharide	L
<b>Bacterium derivatives</b>	<b>L-H</b>
Protein hydrolizate	L
Plant extract 4	L-M
Plant extract 5	L
Plant extract 6	L-M
Resistance inducer (elicitor)	L

\*\*Average levels: L=no efficacy, M=better than untreated, lower than copper, H=as copper

\* Not all products under development were tested in the field and some non-cofree products are included



# Status in the development pipeline

- **2 active substances are approved** (reg. 1107, powdery mildews or apple scab), however limited efficacy against oomycetes
- **3 registration dossier submission is planned** (limiting factor could be the RoI)
- **4 candidates further R&D is needed**

Best case scenario for market introduction for the 3 candidates: **2022**

4 candidates were abandoned

# Right time of application and strategies with low dosage of copper

**Until sustainable alternative(s) (efficacy/cost) available on the market:** copper is needed - improve application of low dosages of copper (resistant/tolerant varieties and DSS)

**When alternative(s) available:** correct application time according mechanism of action, copper may be needed under high level of disease risk (inclusion in low-dosage copper strategies, resistant varieties)

# Thank you for your attention!



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